Re-enJEANeering STEM Education: Math Options Summer Camp

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Abstract

Although the number of women majoring in engineering and engineering technology has increased in the last few decades, percentages lag behind those in other STEM disciplines. Young women often have misperceptions about the nature of engineering, and that leads to lack of interest. Engineering is often seen as men's work. They do not understand how engineers can have a positive impact on society (Hersh, 2000). Math Options Summer Camp, a program that has been conducted during the past two summers, addresses these issues. The week-long camp was designed for girls entering ninth and tenth grade when they still have time to add math and science courses to their schedules. Unlike other summer STEM initiatives, this camp focused on the use of technology: an integrated jean bag project was used to introduce campers to different areas of engineering (electrical, mechanical, and plastics) in hands-on lab-based modules. In this article the camp is described and data on campers' assessments of their experiences is provided. Workshop evaluations showed that the campers particularly enjoyed using technology in the labs and came away from the camp with a broader understanding of STEM careers.

Introduction

The demand for workers in the fields of science, technology, engineering, and math (STEM) is predicted to grow twice as fast as the overall rate of growth for workers in all occupations over the next five years in the United States (National Science Board, 2008). The question is: will there be enough people qualified to meet these demands? The National Center for Education Statistics predicts that the growth of undergraduate enrollments in the STEM fields over the next five years will only attribute to half of the demand for workers (U.S. Department of Education Institute of Education Sciences NCES, 2008). It is evident that something needs to be done to encourage young adults to enter these fields in order to prevent the United States from facing a severe shortage of engineers and scientists in the near future.

One way of addressing the issue is to solve the problem of underrepresentation of women in many of the STEM fields. Table 1 shows the results of a 20-year study by the National Science Foundation (NSF, 2008). Women receiving undergraduate degrees are well represented in science, but they have a long way to go in technology, math, and engineering. Although the number of women in STEM fields is increasing overall, the numbers for math (26.8%), computer science (26.8%), and engineering (19.5%) are still woefully low. It is quite obvious that steps need to be taken to significantly increase the number of women in engineering and technology.

Table 1. Women as a Percentage of Undergraduate Degree Recipients by STEM Major.

STEM major	1986	1996	2006
Biological, agricultural sciences	45.5	50.2	59.8
Earth, atmospheric, ocean sciences	22.3	33.3	41.2
Mathematics, computer sciences	38.8	33.9	26.8
Physical sciences	29.8	37.0	42.4
Engineering	14.5	17.9	19.5

Many factors contribute to the lack of women in the STEM fields, particularly in engineering and technology. One factor is that some girls find the requirements for higher level math and science to be intimidating while in middle school. This may result in a loss of confidence in their ability to do well in these areas, which in turn leads to a lack of interest in pursuing engineering as a career option. Engineering, has been a male-dominant profession, and it is often viewed as a masculine profession (Hughes, 2002). Young girls often prefer to pursue a career that might result in their helping people, and they may find it difficult to see engineering in that light (Hersh, 2000). Research has also shown that girls' awareness in this matter can be increased by exposing them to successful female role models (Haemmerlie & Montgomery, 1991; Plant, Baylor, Doerr, & Rosenberg-Kima, 2009) and by demonstrating that engineering has a positive impact on society.

Colleges and universities across the nation are looking at ways to increase the supply of qualified students coming out of high schools. A variety of STEM outreach programs have been created and developed to specifically target women and other underrepresented groups. Many such programs are one day long; the focus is to introduce young women and/or other underrepresented groups in several age groups to the STEM disciplines. Typically, these programs are comprised of introductory and closing sessions with several small-group activities, which are usually hands-on exercise sessions. Duke University's FEMMES (Females Excelling More in Math, Engineering, and Science) program for girls in 4th – 6th grades (Weston, Bonhivert, Elia, Hsu-Kim, & Ybarra, 2008), and the South Dakota School of Mines and Technology's E-Week GIRLS program for girls from middle school through high school (Karlin, 2005) are examples of such events. The E-Week Girl's program has been very successful in targeting girls from the rural regions of South Dakota. Additionally, Baylor University offers a one-day Girl Scout day camp for both Brownies and Juniors (Fry, Davis, & Shirazi-Fard, 2008).

Penn State Erie, The Behrend College (PSB), a stand-alone college of The Pennsylvania State University, has 4,400 students and is located in Erie, Pennsylvania. PSB organizes two 1-day programs that bring girls to campus for hands-on STEM activities. Women in Engineering was designed for tenth- and eleventh-grade girls and provides an introduction to engineering through hands-on workshop activities. Math Options Career Day was developed for middle school girls and is broadly focused on the importance of math in a wide variety of disciplines.

In addition to single-day programs, another popular vehicle for introducing girls to the STEM disciplines are week-long summer camps. One such example is the Science, Technology, and Engineering Preview Summer Camp for Girls (STEPS for Girls) organized by the University of Wisconsin-Stout that has run for more than a decade. This program specifically targets girls entering seventh grade. It is designed to introduce them to occupational opportunities in STEM and to encourage them to take appropriate math and science courses to prepare for those fields. The main focus is on manufacturing, and they spend the week tracking the manufacturing processes involved in producing a radio-controlled airplane (Bee, Puck, & Heimdahl, 2007). Grand Valley State University runs essentially the same STEPS program (Plotkowski, Sheline, Dill & Noble, 2008). The University of Arkansas has a summer day camp for middle school girls aimed at increasing their interest in STEM fields (Burkett, Small, Rossetti, Hill & Gattis, 2008). This is done through a series of hands-on activities throughout the week. All of the activities are designed to be both fun and educational. Projects range from 3D modeling of a simple box with a personalized lid to the programming of a robot.

The goal of this article is to describe a newly designed summer camp, known as Math Options Summer Camp, for tenth- and eleventh-grade girls, which was held at PSB in 2008 and 2009. This unique theme-based camp covers multiple engineering, engineering technology, and science majors. The camp was run in two distinct parts with the engineering and engineering technology portion in the mornings and the natural and social sciences in the afternoons. The article focuses on the engineering and technology sessions held in the morning. This portion of the camp was specifically designed to establish engineering as a fulfilling career option that requires strong math skills.

Overview of Math Options Summer Camp

The Math Options Summer Camp (MOSC) was developed as an extension of a one-day signature Math Options Career Day held annually for the past thirteen years at PSB. The Math Options Summer Camp was designed to provide more in-depth investigation of STEM careers for girls at the high school level (entering ninth or tenth grades). The weeklong camp has a number of benefits over a one-day event in that more time can be dedicated to the workshops and labs, and projects can be carried over from one day to the next. The format also allows daily interaction with college-aged student mentors and substantial amounts of time spent with PSB faculty and staff. Recreational time allows the girls to strengthen newly formed friendships.

The engineering and technology component of the camp was developed with a number of goals in mind. It was designed around the re-engineering of an existing product (a pair of blue jeans) to create a brand new product (a blue jean bag) that was relevant to the girls and could

be completed in 14 hours. The project had to be multidisciplinary and involve hands-on activities in different areas of engineering and technology that matched the girls' abilities and skill set. The project needed to demonstrate how engineering affects people's everyday lives and positively impacts society. Because bags are a common accessory used by young girls, the jean bag was something the girls could easily relate to, thereby making the introduction of the fun aspects of engineering relatively easy. The use of an existing pair of jeans to design a new product introduced the concept of recycling. Requiring the girls to make a product that would be later used for a donation helped accomplish these goals. In order to provide individualized attention and ensure lab safety, the camp was limited to 15 participants. One important goal was to provide positive role models of achievement; thus, the majority of the labs were instructed by female faculty members. College students in STEM majors were hired as mentors. These students received special training on gender issues and how to successfully interact with girls this age. The camp was funded through the Pennsylvania Educational Improvement Tax Credit Program (EITC). This allowed a low registration fee of $125 and the availability of full and half scholarships to girls that demonstrated a financial need. Transportation stipends were also provided to families in need. The camp provided the girls with an opportunity to experience multiple engineering processes and the technology used to design and manufacture a product from beginning to end.

The theme of the engineering portion of the camp was called "Re-enJEANeering" due to the nature of the product being designed. Over the course of the week the girls designed and manufactured jean bags. Since creativity was an important aspect of this camp, the girls were not constrained to making a particular kind of bag. Instead they were allowed to make a bag of any style. A purse, a scrapbooking tote bag, or a BBQ tool holder, are a few such examples.

The camp started with a team building and leadership workshop, and then the students were given an introduction to the product and how it relates to engineering. This was followed by development and construction of their design ideas in the various engineering labs. Finally an applicable business model lesson was given. Throughout the week there was laughter, learning, and personal development by all those involved in the camp. The student mentors and faculty enjoyed the camp as much as the girls. The following sections describe each segment of the camp in detail.

Teamwork Workshop

The opening workshop was designed to help the girls get to know each other and to teach them about successful team work. Other learning objectives included an examination of the factors that relate to team performance, such as an individual's previous experience, cognitive variables such as memory, problem solving and spatial skills, and emotion regulation in the face of stress. The challenge is based on the Jungle Escape Game (teambuilding training game) developed by HRDQ, Inc.

The campers were asked to imagine that they were stranded in the jungle after a plane crash. They had to assemble parts (K'NEX®) to create a helicopter to fly them out of the jungle before monsoon rains started. Campers were assigned to three teams of four to five students. One member of the team was assigned to be the scientific observer and record information about the team's activities and performance. Assembly was limited to 40 minutes, and after 20 minutes the first observer chose a successor. The observer could not speak or help build the helicopter. Students were given a black and white photo of the helicopter and one at a time could look at a model behind a screen. They could not bring pieces with them or touch the model; they had to rely on their memories. When the helicopter was complete, a facilitator checked it for completeness.

In this activity, it is typical for some teams to work well together and finish early while other teams take longer or do not finish in the allotted time. When finished, the team members answered questions through which they analyzed the strengths and weaknesses of their performance. They discussed emotional regulation and the positive and negative emotions that result from working on a challenging problem. One important topic was how leaders both, emerge in teams and harness the strengths of the team members. Various diversity issues were discussed. For example, is it fair to have to use K'NEX® building toys which some campers have never used and tend to be played with more by boys? At the end of the activity, the students were placed into Red and Blue Teams and introduced to their

college student mentors and many of the faculty that they worked with throughout the week.

Introduction to the Jean Bag Project

This second workshop began with a discussion of what the engineering profession is all about. It was important for the participants to understand what an engineer is and the significant impact she/he can have on society. The workshop emphasized the fact that products used by the participants in their day-to-day life cannot be manufactured without the involvement of an engineer. A clear understanding of how different fields of engineering contribute to society on many different levels was provided.

Once the attendees had a better understanding about engineering, the design project was introduced. This entailed a discussion of how engineering faculty came up with the idea of Re-enJEANeering and the process that would be followed. It also included demonstrations and examples of both failed and good prototypes, emphasizing that the finished product very rarely looks like the initial idea. The girls learned the importance of being flexible and open to various ideas that are not necessarily their own to ensure an end product of optimum quality.

Constraints and requirements for the product were established, giving campers an opportunity to be creative and still experience a part of practical bounds. The bag was to have at least one handle, at least one ring to connect the handle to the bag (Figure 1), fasteners such as rivets, snaps, Velcro, magnets, or grommets, and one sewn seam. The handles, rings, and fasteners were to support the weight they were designing for, plus 30% of that weight. The students were also asked to complete two bags—one for themselves and one to donate to a community agency called SafeNet that serves women and children.

Figure 1. Examples of ring styles that were available for use.

Before the campers began the design process, they were shown the NIGHTLINE television broadcast video "Deep Dive" (ABC News Productions, 1999) featuring a company called IDEO, located in Palo Alto, California, illustrating a user-centered process for designing products. This company uses a unique approach to brainstorming called the "Deep Dive." Their approach focuses on having a multidisciplinary team of employees (e.g., anthropologists, psychologists, business professionals, and engineers) totally immerse themselves in the design problem. In this video, the team follows a full design process to redesign a grocery shopping cart. In just five days the multidisciplinary team brainstorms ideas, conducts research, develops multiple prototypes and gathers user feedback.

This video does a very good job of showing how individuals from different backgrounds with different levels of training can work together to develop a usable product. The teamwork represented in the video is something that was incorporated in the Math Options Summer Camp. It also provided insight into what was expected of the campers during the design process.

Ergonomic Bags Workshop

The goal of this activity was to familiarize the campers with the general concept of human factors and how to design an ergonomically correct bag. The first step was to review human factors and ergonomics. The goal of human factors engineering is to improve interactions between humans and systems; specifically it is focused on improving performance, safety, and user satisfaction. The field of ergonomics addresses the relationship between the human body and the environment (Karwowski, 2006).

A backpack was used as an example of ergonomics. Different backpack sizes are recommended based on the user's size and weight, and the campers were provided with information based on different clinical studies. The American Chiropractic Association (ACA) and the American Academy of Orthopedic Surgeons (AAOS) have provided guidelines for backpack weights, sizes, and usage for children. Experts

recommend that the backpack be no more than 10-15% of the child's weight, and it should never exceed more than 20% of a child's weight (O'Neill-Grace, 1999).

In a group activity, campers weighed themselves and then calculated the ideal weight for their backpack (10%-15% of body weight) and the maximum weight (20% of body weight) for their backpack. A discussion session followed to review the impact of backpacks that are too heavy. The attendees came up with examples of what could happen to their bodies if they were carrying a backpack that was too heavy (e.g., headaches, shoulder discomfort, neck pain, and issues with posture). They also discussed the importance of the position of the backpack. At the end of the activity, campers better understood the characteristics of an ergonomically correct backpack. The campers then reviewed ways to make an existing backpack ergonomically correct (e.g., placing heavy things in the bottom of the backpack to help distribute the weight more equally), and they discussed methods of carrying their backpacks correctly.

All of the camp activities needed to be relevant to the jean bags project; therefore, the next step was to apply backpack design recommendations to other bags, including purses. The attendees came up with ways to apply the ergonomically correct design concepts from the backpack to bags. They discussed choices in strap size and strap length, depending on the size of the bag. For example, bags designed to carry less weight can have narrow, long straps in contrast to bags designed to carry more weight, which need wider, shorter straps so that the straps do not dig into the user's shoulder. The session ended with the attendees discussing how they could incorporate these ideas in their bag designs.

Mechanical Engineering Workshop

On the morning of the second day, campers went to several of the mechanical engineering labs. The goal was to give the girls an opportunity to understand the fundamentals behind mechanical engineering and also give them a sense of mechanical engineering as a career option and its relation to everyday products. The project design required the bag to have at least one ring to attach the handle to the bag. In this segment, the attendees modeled rings for their final product using computer-aided-drafting (CAD) and analysis tools used by professional mechanical engineers. They also worked with test machines in the mechanical engineering laboratories.

The session began with a discussion of different options available for temporary and permanent fasteners. These options included rivets, screws, nuts, stitching, glue, and so on. The discussion moved on to the availability of rings in different shapes, sizes, and materials, as shown in Figure 1. The students modeled rings in two different shapes: a round ring and a D-ring using a CAD tool called Pro/ENGINEER®. The stress plots for several of the rings were completed using a finite element analysis package called ANSYS®. Computer simulations were followed by hands-on activities. This included a visit to the materials-testing laboratory on campus.

Campers were split into two groups and each group completed two activities. In one activity, campers were given test samples of rings both of different sizes and made with different materials, such as brass, plastic, and steel. A 10kN capacity Tinius-Olsen Benchtop Universal Test machine was used to see how much weight each ring could support before it failed. Campers performed these tests and drew conclusions regarding the various test samples. The smaller metal rings tended to break, plastic rings elongated before they broke, and the jean fabric ripped before the larger metal ring broke. This exercise helped determine the appropriate material and size for the rings that would support the maximum amount of weight for each camper's bag. In the second activity, campers moved to the manufacturing processes laboratory and learned to cut holes through multiple layers of jean fabric using a drill press as a punch, a crafter's punch, and an awl. They also learned how to use an Arbor Press to set rivets and grommets.

During the week, impromptu testing was completed as necessary. For instance, students could decide to use materials not normally recommended to be used as handles for their bags. Faculty helped the students determine whether their idea was feasible or not.

Cutting Steel and Plastic Engineering Workshop

The plastics engineering workshop was held on the third day of camp in the general manufacturing and plastics laboratories. Campers spent time observing and participating in various part production methods with the intention of gaining an understanding of how things

are made. This information was then related to the jean bag project.

In the design choices for the bags, campers had several options for plastic or metal fasteners and components. In the general manufacturing laboratory, campers were exposed to multi-axis computer-numerical-controlled (CNC) machining centers, and they were given an explanation of the different types of metals. Manufacturing methods were described and demonstrated, and the girls were able to participate in some aspect of the manufacturing method and/or the application of the fasteners. This allowed them hands-on time in the fabrication laboratory where they were able to try milling, drilling, hand threading, and riveting, as well as spot, tig, and mig welding.

These activities were followed by a visit to the plastics laboratory where they were introduced to the processes by which raw plastic materials are converted into plastic parts. Each attendee was given a primer on materials and processes after which they advanced to mixing their own colored material; they used injection molding to create their own personalized part (in this case a Frisbee-style disc). They also operated a thermoformer and produced Penn State Nitanny Lion head-shaped forms. At the end of this session, the students had a better understanding of metals and plastics and how parts are manufactured.

Flower Power: Electrical Engineering Workshop

In order to incorporate the electrical engineering component during the design phase of the product, camp participants were brought to the electrical engineering laboratories where they put together a simple circuit using some basic electrical components. At the end of this workshop, participants learned how to solder, which is an important skill for professional electrical engineers. The girls built a device that was a source of light, was battery operated, and was small enough to put in their jean bag. The motivation was to be able to use this handy device to find keys and other small items that tend to get lost inside purses.

The name of the workshop was "Flower Power," because the printed circuit board (PCB) was shaped as a flower. The petals of the flower represented the area where electrical components (potentiometers) are soldered. The potentiometers are variable resistors that look like circular dials. At the center of the PCB a multicolored light emitting diode (LED) was soldered. The LED provided a source of light that could be turned on using a 9-V battery. The potentiometers were used to change the color of the light emitted by the LED.

Due to time constraints, the circuit was predesigned. Kits were put together with the printed circuit board and the various components to build the circuit. Campers were provided with soldering irons, soldering wire, safety glasses, and wire clippers. A Hershey's Kiss was included as part of the kit so that the attendees could easily visualize what a solder joint should look like. After a brief demonstration at the beginning of the workshop, participants soldered their components on to the PCB (see Figure 2) and created a product that could be used with their jean bags to increase its usefulness.

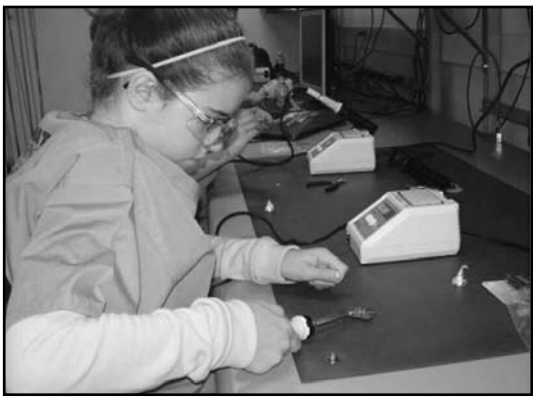

Figure 2. A camper soldering wires to her printed circuit board (PCB) in the Flower Power workshop.

Optimizing Profits Workshop

PSB offers an Interdisciplinary Business with Engineering Studies Major (IBE), which motivated the authors to introduce a "business" component to the camp. The discussion during this workshop focused on how the re-enJEANeered bags could be produced for profit. The camp's participants were asked to come up with different business models. For instance, campers discussed the ideas of selling the bags at craft shows, birthday parties, retail stores, a shop or kiosk, and selling them online.

Attendees were divided into different groups based on the business models they suggested. The girls were given time to brainstorm and come up with the materials required to start their businesses. The girls tended to think beyond basic requirements like tables and a cash register; and considered issues like how they

would store and transport their supplies and products.

Campers then performed a cost analysis to decide if a profit could be made based on the current design. Based on the experience of the first four days of camp, they calculated the costs associated with making the bag. A list of all the materials that they had access to throughout the week was provided to them. This list included actual purchase prices and estimated costs for items that were donated. Campers were also required to take into account materials that are not clearly visible, for instance, thread to sew on a button, or hot glue to add embellishments. Costs ranged from under a dollar to around $10.00.

After the cost of raw materials was established, there was a discussion regarding other costs to starting a business, such as rent and labor. Groups decided which business model would be the most successful. This led to a lively discussion on how their businesses could be made profitable. Campers discussed options such as selling their bags at a high price, cutting costs by utilizing space at home, selling online, simplifying the design to cut costs, and purchasing supplies on sale or on clearance. This activity concluded the design cycle of the product.

Wrap Up and Parent Reception

As discussed in the introduction, research shows that one of the reasons why girls do not pursue a degree in engineering is that they do not understand how engineering can make a difference to society. In order to emphasize that engineers help people every day, the girls designed and built two jean bags, as shown in Figure 3. One bag was for the camper to keep and the other was donated to SafeNet, a domestic violence organization in Erie, Pennsylvania. Campers learned how some women and young girls need to escape from a violent situation and leave everything behind. The second bag was filled with items to make life easier for women and children in unfortunate situations. The girls did a great job decorating the bags and often added inspirational messages. At the final presentation to the parents and donors, the participants presented the bags to a representative from SafeNet.

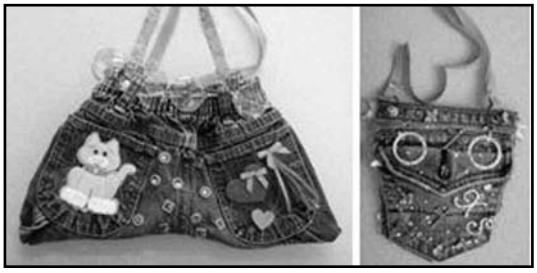

Figure 3. Examples of finished purses.

An overview of engineering careers was also provided to the girls, including aerospace, chemical, civil, computer, electrical, industrial, mechanical, materials, plastics, petroleum, and software engineering fields. In order to provide a good understanding of each of these fields, campers discussed how each of the engineering fields was involved in the design and development of an aircraft. Information was provided regarding engineering majors offered on Behrend's campus, which include computer, electrical, mechanical, plastics, software engineering, and interdisciplinary business with engineering studies and how the week's activities were related to these majors. They were provided with links to the *Sloan Career Cornerstone Center* and *Engineer Your Life*, which provide information about engineering careers, what engineers do, and what steps the girls need to take in high school to pursue one of these majors.

Program Assessment

Based on the goals of the program an assessment strategy was developed in which campers' attitudes about the STEM disciplines were measured before and after the camp using a computerized survey. Each workshop was individually evaluated using closed- and open-ended questions. The first analysis compared the results from the 2008 and 2009 camp sessions. The results of independent sample t-tests found no significant differences (*ps* > .05). Therefore, in the following analyses, the data for the two years are analyzed together with 28 campers, 2008 (N = 13) 2009 (N = 15). The data reported here are from the morning sessions that represent the engineering part of the camp and revolved around the Jean Bag Project.

Pre-camp and post-camp surveys. When the students first arrived they were directed to a Web site specifically designed for the program. Students completed a brief questionnaire where they rated a series of statements on a scale of 1 = strongly disagree to 5 = strongly agree. At the end of the program students answered the same questions. Table 2 shows the means (M) and standard deviations (SD) of the pre-camp and

post-camp responses. Overall, students were very positive about the STEM fields coming into the program, so it is not surprising that they remained positive at the end. The majority of questions show mean post-camp scores somewhat more positive than pre-camp scores, but paired sample t-tests did not reach statistical significance (*ps* > .05).

Workshop evaluations. After each workshop, the students completed a brief four- question assessment. Open-ended questions asked campers what they liked the most and the least. For the ratings, participants used a scale of 1 = strongly disagree to 5 = strongly agree, as to whether the workshop wasinteresting and enjoyable and increased their understanding of the topic. Paired samples t-tests were conducted to compare the 2008 and 2009 groups, and the results showed no differences, therefore the data reported in Table 3 included all participants. The results showed that the workshops were rated highly, with the majority of responses (93%) either agreeing or strongly agreeing that the workshops were both interesting and enjoyable and that they increased their understanding of the topic. The workshops that were considered most interesting and enjoyable were the Flower Power and Cutting Steel workshops. The least highly rated was the Optimizing Profits workshop. The campers' comments suggested that they were less positive about Optimizing Profits because it was less hands-on/laboratory-based than the other workshops.

Overall assessment. The post-camp survey also included seven statements that were designed to assess campers' overall feelings about the Jean Bag project and about Math Options Summer Camp in general. They were also asked about the college student mentors. The results showed that the Jean Bag project was both fun (*M* = 4.59, *SD* = .694) and educational (*M* = 4.04, *SD* =.81). Students reported nearly unanimous agreement with the statement that they would recommend the camp to other students (*M* = 4.78, *SD* = .577). The highest ratings were for the interaction with the college student mentors. Campers felt strongly that they were good role models (*M* = 4.81, *SD* = .396) and enjoyed working with them (*M* = 4.89, *SD* = .32). Most campers wanted to stay in touch with each other after the camp (M = 4.56, SD = .698).

Conclusions

The Math Options Summer Camp program has now been implemented for two years and overall it has been successful. The results of the evaluations show that the campers were very positive about the experience and left the camp knowing much more about specific STEM disciplines. Attitudes about the STEM fields were strong coming into the camp and, therefore, did not significantly improve, but this suggests that educators should reach out to a broader segment of the population. Recruitment is one area that could be improved. The authors intended to target less affluent and more diverse participants and offered scholarships to help support the costs, but were only partially successful. Many high school students from less affluent backgrounds need to work during the summer months or care for younger children, and they often do not have transportation to campus.

Although developing and implementing the program was extremely time consuming, the

Table 2. Means and Standard Deviations (SD) of Ratings on the Pre-camp and Post-camp Surveys. Paired sample t-tests and p values are also shown.

Pre-Camp		Post-Camp				Statement
Mean	SD	Mean	SD	t	p	
3.85	1.29	3.77	1.33	.57	.57	I like math.
4.07	0. 96	4.26	0.81	1.55	.13	I like science.
4.30	1.10	4.59	0.69	1.49	.15	I am considering a career in a math or science field.
4.33	0.92	4.48	0.80	1.65	.11	In high school I will take math or science courses even if they are not required.
4.37	0.74	4.59	.57	1.65	.11	It is important for everyone to have a basic understanding of Science, Technology, Engineering, Math (STEM).
3.44	1.19	3.74	1.26	1.35	.19	Women are not encouraged as much as men to go into STEM fields.

experience has been valuable for establishing and strengthening interdisciplinary relationships among faculty and staff. In working together on these integrated projects, everyone learned more about the others' discipline and how they often overlap and complement each other. The college student mentors also reported a very positive experience; not only did they learn more about the wide variety of STEM fields, but they also realized how rewarding it is to work with young people.

The logistics of implementing intensive STEM education outreach programs can be daunting. At PSB, the Continuing Education Office orchestrated the administrative details, such as obtaining funding, recruiting and registering the campers, and providing key staff support. The Psychology building, centrally located on campus, was used as the "clubhouse" for the program. Starting and ending each day in one place gave the campers a sense of familiarity and identity. For the academic institution, just beneath the more altruistic reasons for outreach activities lies the secondary hope that they will aid in recruiting good students. Although the primary goal was to increase knowledge and interest in STEM careers, the camp also brought young girls to this campus and most (80%) reported planning to apply to PSB for college.

At the end of the camp, students were asked to describe in their own words how this experience influenced their attitudes about careers in STEM. For those already interested in STEM careers, the camp illustrated the wide variety of fields within a discipline. For example, one camper said, "I knew I liked engineering when I came here, but I didn't know all of the different types and what they consisted of."

For undecided students, the camp provided a mind-opening experience, "I think it encouraged me to keep my mind open for different careers and career choices." For others the camp challenged some of their stereotypes. One girl wrote, "I learned that engineering is not working in an office. There is so much field work that is a lot of fun… Also engineering really helps people. We couldn't survive without all the things made by engineers." Students also began to think about gender roles and their limitations. One student commented, "It helped me learn more about careers that are mostly considered men's work, I am now considering other careers that I would not have originally thought of."

When the campers were asked how they would improve the camp the most common response was to make it longer and to let the campers stay in the dorms overnight. Students were overwhelmingly positive; one camper summed it up well, "Math options was a blast this year!! Thanks for letting me have the opportunity to come here and learn and have fun. It was awesome!"

Table 3. Results of Workshop Evaluations. Means (M) and Standard Deviations (SD) for Ratings of Enjoyment (Enjoy) and Understanding (Understand). Representative Comments for "Liked the Most" and "Liked the Least" Questions

Workshop		Enjoy	Understand	Liked the most	Liked the least
Teamwork	M	4.57	4.54	building the helicopter	observing instead of building
	SD	0.63	0.64	fun to work with my team	time limits
Ergonomics	M	4.29	4.37	weighing the bags	PowerPoint
	SD	0.76	0.69	how much you should carry	sitting too long
CAD/	M	4.30	4.15	working on computers	confusing
Analysis	SD	0.78	0.91	using engineering technology	messing up the model
Breaking	M	4.63	4.42	using the machines	like to test more things
Stuff	SD	0.56	0.76	breaking stuff!	confusing instructions
Flower	M	4.81	4.52	making the light	confused about the wiring
Power	SD	0.48	1.05	using the soldering iron	700 degrees hot
Cutting	M	4.86	4.61	welding is awesome	noisy
Steel	SD	0.36	0.74	the cool masks	waiting round
Plastic is	M	4.61	4.57	getting the bottles	waiting for machines
Fantastic	SD	0.83	0.74	seeing the stuff made	standing around
Optimizing	M	3.78	3.89	finding the cost	a little confusing
Profits	SD	1.12	1.01	how to make money	listening

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